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SECURE HASH STANDARD

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^ is used for exponentiation or superscript. \*\*\*/

CATEGORY: COMPUTER SECURITY

U.S. DEPARTMENT OF COMMERCE, Barbara Franklin, Secretary  
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Foreword

The Federal Information Processing Standards Publication Series of the National Institute of Standards and Technology (NIST) is the official series of publications relating to standards and guidelines adopted and promulgated under the provisions of Section 111(d) of the Federal Property and Administrative Services Act of 1949 as amended by the Computer Security Act of 1987, Public Law 100-235. These mandates have given the Secretary of Commerce and NIST important responsibilities for improving the utilization and management of computer and related telecommunications systems in the Federal Government. The NIST, through the Computer Systems Laboratory, provides leadership, technical guidance, and coordination of Government efforts in the development of standards and guidelines in these areas.

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Abstract

This standard specifies a Secure Hash Algorithm (SHA) which can be used to generate a condensed representation of a message called a message digest. The SHA is required for use with the Digital Signature Algorithm (DSA) as specified in the Digital Signature Standard (DSS) and whenever a secure hash algorithm is required for federal applications. The SHA is used by both the transmitter and intended receiver of a message in computing and verifying a digital signature.

Key words: Computer security, digital signatures,  
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ederal Information Processing Standard, hash algorithm.

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ANNOUNCING THE  
SECURE HASH STANDARD

Federal Information Processing Standards Publications (FIPS PUBS) are issued by the National Institute of Standards and Technology (NIST) after approval by the Secretary of Commerce pursuant to Section 111(d) of the Federal Property and Administrative Services Act of 1949 as amended by the Computer Security Act of 1987, Public Law 100-235.

Name of Standard: Secure Hash Standard.

Category of Standard: Computer Security.

Explanation: This Standard specifies a Secure Hash Algorithm (SHA) for computing a condensed representation of a message or a data file. When a message of any length  $< 2^{64}$  bits is input, the SHA produces a 160-bit output called a message digest. The message digest can then be input to the Digital Signature Algorithm (DSA) which generates or verifies the signature for the message (see Figure 1). Signing the message digest rather than the message often improves the efficiency of the process because the message digest is usually much smaller in size than the message. The same hash algorithm must be used by the verifier of a digital signature as was used by the creator of the digital signature. The SHA is called secure because it is computationally infeasible to find a message which corresponds to a given message digest, or to find two different messages which produce the same message digest. Any change to a message in transit will, with very high probability, result in a different message digest, and the signature will fail to verify. The SHA is based on principles similar to those used by Professor Ronald L. Rivest of MIT when designing the MD4 message digest algorithm ("The MD4 Message Digest Algorithm," Advances in Cryptology - CRYPTO '90 Proceedings, Springer-Verlag, 1991, pp. 303-311), and is closely modelled after that algorithm.

Approving Authority: Secretary of Commerce.

Maintenance Agency: U.S. Department of Commerce,  
National Institute of Standards and Technology, Computer Systems Laboratory.

Applicability: This standard is applicable to all Federal departments and agencies for the protection of unclassified information that is not subject to section 2315 of Title 10, United States Code, or section 3502(2) of Title 44, United States Code. This standard is required for use with the Digital Signature Algorithm (DSA) as specified in the Digital Signature Standard (DSS) and whenever a secure hash algorithm is required for federal applications. Private and commercial organizations are encouraged to adopt and use this standard.

Applications: The SHA may be used with the DSA in electronic mail, electronic funds transfer, software distribution, data storage, and other applications which require data integrity assurance and data origin authentication. The SHA may also be used whenever it is necessary to generate a condensed version of a message.

Implementations: The SHA may be implemented in software, firmware, hardware, or any combination thereof. Only implementations of the SHA that are validated by NIST will be considered as complying with this standard. Information about the requirements for validating implementations of this standard can be obtained from the National Institute of Standards and Technology, Computer Systems Laboratory, Attn: SHS Validation, Gaithersburg, MD 20899.

Export Control: Implementations of this standard are subject to Federal Government export controls as specified in Title 15, Code of Federal Regulations, Parts 768 through 799. Exporters are advised to contact the Department of Commerce, Bureau of Export Administration for more information.

Patents: Implementations of the SHA in this standard may be covered by U.S. and foreign patents.

Implementation Schedule: This standard becomes effective October 15, 1993.

Specifications: Federal Information Processing Standard (FIPS 180)  
Secure Hash Standard (affixed).

Cross Index:

- a. FIPS PUB 46-1, Data Encryption Standard.
- b. FIPS PUB 73, Guidelines for Security of Computer Applications.
- c. FIPS PUB 140-1, Security Requirements for Cryptographic Modules.
- d. FIPS PUB XX, Digital Signature Standard.

Qualifications: While it is the intent of this standard to specify a secure hash algorithm, conformance to this standard does not assure that a particular implementation is secure. The responsible authority in each agency or department shall assure that an overall implementation provides an acceptable level of security. This standard will be reviewed every five years in order to assess its adequacy.

Waiver Procedure: Under certain exceptional circumstances, the heads of Federal departments and agencies may approve waivers to Federal Information Processing Standards (FIPS). The head of such agency may redelegate such authority only to a senior official designated pursuant to section 3506(b) of Title 44, United States Code. Waiver shall be granted only when:

- a. Compliance with a standard would adversely affect the accomplishment of the mission of an operator of a Federal computer system; or
- b. Compliance with a standard would cause a major adverse financial impact on the operator which is not offset by Government-wide savings.

Agency heads may act upon a written waiver request containing the information detailed above. Agency heads may also act without a written waiver request when they determine that conditions for meeting the standard cannot be met. Agency heads may approve waivers only by a written decision which explains the basis on which the agency head made the required finding(s). A copy of each decision, with procurement sensitive or classified portions clearly identified, shall be sent to: National Institute of Standards and Technology; ATTN: FIPS Waiver Decisions, Technology Building, Room B-154, Gaithersburg, MD 20899.

In addition, notice of each waiver granted and each delegation of authority to approve waivers shall be sent promptly to the Committee on Government Operations of the House of Representatives and the Committee on Government Affairs of the Senate and shall be published promptly in the Federal Register.

When the determination on a waiver applies to the procurement of equipment and/or services, a notice of the waiver determination must be published in the Commerce Business Daily as a part of the notice of solicitation for offers of an acquisition or, if the waiver determination is made after that notice is published, by amendment to such notice.

A copy of the waiver, any supporting documents, the document approving the waiver and any accompanying documents, with such deletions as the agency is authorized and decides to make under 5 United States Code Section 552(b), shall be part of the procurement documentation and retained by the agency.

Where to Obtain Copies of the Standard: Copies of this publication are for sale by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. When ordering, refer to Federal Information Processing Standards Publication 180 (FIPS PUB 180), and identify the title. When microfiche is desired, this should be specified. Prices are published by NTIS in current catalogs and other issuances. Payment may be made by check, money order, deposit account or charged to a credit card accepted by NTIS.